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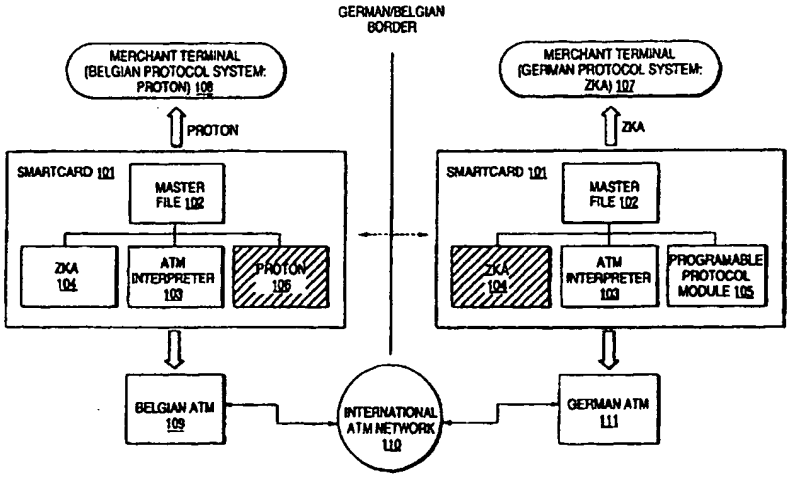

(57) Abstract

The present invention relates to a smart card (101) for financial transactions that can be programmed to operate using a variety of applications. The cart includes an interpreter (103) that interfaces the smart card and an automatic teller machine (109, 111) or merchant terminal (107, 108). The card includes a plurality of application modules each of which contain application programming that can be used by the interpreter to manage the card-to-system interface. At least one of the application modules (104, 105) can be reprogrammed to provide application programming for the interpreter that is compatible with the locally prevalent application program used by the automatic teller machines and card terminals in the area where the cardholder is traveling.

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A METHOD AND SYSTEM FOR USING AN APPLICATION PROGRAMMABLE SMART CARD FOR FINANCIAL TRANSACTIONS IN MULTIPLE COUNTRIES

FIELD OF THE INVENTION

The present invention relates to the field of smart cards for conducting financial transactions. More particularly, the present invention relates to a smart card that can be programmed with the proper application to transact with automatic teller machines and merchant terminals in any area to which the cardholder is traveling.

BACKGROUND OF THE INVENTION

Credit cards, debit cards, and automatic teller machine cards are widely used by consumers around the world to access, transfer and spend money. These cards make use of a magnetic strip disposed on the back of the card which is encoded with information about the cardholder and the account or accounts accessed by the card. Terminals, which may be automatic teller machines (ATMs) or merchant terminals at a place of business or point of sale, are used to read the coded information on the card and access the cardholder's account to complete a financial transaction.

Besides the well-known credit and debit cards, stored value cards are becoming increasingly popular. A stored value card is a card that is purchased or established for a specific monetary amount. That monetary amount is stored as the value of the card. When the cardholder desires to use the stored value card to purchase goods or services, the card is presented at the point of sale and the cost of the goods or services purchased is deducted from the value of the card.

The cardholder may continue to use the stored value card in this manner until all the value has been removed from the card. The card may then be discarded user of the care may provide a method for replenishing the value of the card. Such cards are commonly used today as a means for paying subway fare and making phone calls.

The development of such convenient financial instruments has also produced "smart cards" which are especially popular in Europe. Rather than employing information encoded on a magnetic strip, smart cards incorporate a microprocessor which is embedded in the card and can interact with the ATM or merchant terminal to provide information about the cardholder or the cardholder's account, transaction authorization, or other information. Various smart card designs and applications are described in the following U.S. Patents which are

incorporated herein by reference: U.S. Patent Nos. 4,766,293 (Boston); 4,868,376 (Lessin et al.); and 4,874,935 (Younger).

Advanced smart cards, called very smart cards, may even include a battery, a keypad and an LCD display on the face of the card. However, due to the expense of such advanced cards, typical smart cards have no keypad or display and look like other plastic credit cards. Because the microcomputer is embedded in the smart card body, the card surface must include electrical contacts which function as a communications port to interface the microcomputer in the card with a processor in an ATM or a merchant terminal. The power, input, and display for a smart card microcomputer is thus provided by interfacing the card with an ATM or merchant terminal.

A smart card terminal must be provided with a detection mechanism to determine when a smart card has been inserted and that the card is properly positioned To be properly positioned, the communications contacts on the card must be in contact with electrical contacts that communicate with the terminal processor. Once the smart card is properly positioned, the terminal will provide power to the microcomputer on the card and send a reset (RST) signal to the card. The card uses the RST signal to reset itself or to initiate an internal reset

function. When the card is reset, it sends the terminal an standard applications (i.e., software) being executed by and with the cards.

The usefulness of a credit or debit card, whether a smart card or a magnetic strip card, is largely determined by how widely the card is accepted. In the case of a smart card, a bank will attract more customer if the smart cards it issues can be used to access money at many ATMs and to make purchases at many places of business. A merchant will attract more customers if he or she provides a merchant terminal that can interact with the smart cards that customers carry. Thus, both banks and merchants will have an incentive to create a system of compatible smart cards and terminals in their country or region. This may lead to a de facto compatibility standard or the government or a business association authority may actively establish compatibility standards in a particular country or region.

However, smart card and system compatibility will not necessarily or even likely extend beyond the country or region where compatibility has been established unless there are answer-to-reset (ATR) signal. The ATR signal informs the card terminal of basic information about the

card so that communications between the card and the terminal can be established accordingly.

Smart cards can be designed to operate as stored value cards, credit cards, debit cards, ATM cards, calling cards, etc. A smart card may also be designed to perform any combination of these various functions. However, the ability to readily program a smart card and the broad range of possibilities for doing so allows compatibility problems to arise between different smart cards and supporting systems.

In order for travelers to be able to use smart cards throughout the world for financial transactions, cards and card terminals in one country or region must be compatible with cards and card terminals in other countries or regions. To make smart cards compatible with systems around the world, there must be physical standards for the actual construction of the cards, standards for the functioning of the cards, and strong retail ties at the consumer level that cross the national or regional border. Thus, if smart cards and terminals in each country or region are constructed differently, function differently or use different application programs, a smart card cannot be used outside the area where it was issued. Accordingly, there is a need for a

smart card and a supporting system that can allow a smart card to operate with a variety of incompatible systems.

Global standards for the physical construction of smart cards have been established and widely accepted. The International Standards Organization (ISO) standard 7816-1 to -6 specifies the physical characteristics of smart cards such as the size, composition, placement of electrical contacts, the electrical interface, the method of data transmission for smart cards i.e. T=0, T=1 etc., the interface message format and identification of applications stored in the card.

While ISO standard 7816 has largely led to uniformity in the physical construction and communication protocol of smart cards, the standard does not specify the operating system or the application programming to be used. The operating system a smart card uses is the software that tells the microcomputer on the smart card how to execute application programs. For example, the Disk Operating System (DOS) used by IBM-compatible desktop computers or System's used by Apples Machintosh computers are operating systems.

A smart card operating system (SCOS) is established by the manufacturer of the microcomputer embedded in the smart card. To protect it from being erased or modified, the SCOS will likely be hard-wired or masked onto the

semi-conductor chip of the card's microcomputer and/or partially stored in EEPROM. Because there are relatively few manufacturers of smart cards in the world and because smart cards are now produced that can function using more than one operating system, lack of a standard operating system is not seen as a significant obstacle to making smart cards compatible in a variety of countries or regions.

Similarly, the protocol used by smart cards is not a barrier to compatibility across national and regional borders. The International Standard Organization has defined two standard methods for structuring information for transmission between a smart card and an ATM or merchant terminal. They are: the character mode protocol (T=0), and a block mode protocol (T=1). As part of the power up sequence, an Automatic Termination Response (ATR) message is returned from the smart card to identify the transmission protocol it supports. Both transmission protocols are widely accepted by either ATM's or merchant terminals, and some smart cards can function using either the T=0 or T=1 protocols. Based on the ATR message, the terminal and smart card can then agree on a protocol and transact. Thus, smart card protocol is not an obstacle to global compatibility.

The principal difference that prevents smart cards of one country or region from being compatible with terminals in another country or region is the application program used. In this context, an application program is a piece of software for managing financial transactions. The computer in an ATM or merchant terminal executes an application program in conjunction with application programming in the microcomputer on the smart card. Even if a smart card and an ATM are physically compatible and use the same SCOS and protocol, transactions cannot be conducted if the program being run by the ATM and the programming on the smart card are not compatible. Further complicating the problem is the fact that smart cards and terminals may likely use different application programs depending on the how the card is being used. For example, if the card is being used as a stored value card the card terminal will likely be running a different program than if the same card is being used as a credit card.

In general, the program being run by an ATM or other card terminal and the programming on a smart card may be incompatible in three principal areas: 1) security algorithms, 2) access conditions, and 3) data structure. Because smart cards are as easily programmed as any computer, a variety of application programs have been

developed by different authorities, in different countries and regions which are incompatible with each other.

In Europe for example, the ATMS in each generally have a standardized national application stored value cards that is different from the applicable program used in other countries. Thus, for example smart card functioning as a stored value card cannot be used in Belgium where Belgian stored value cards are accepted.

One solution to the problem of diverse application programs would be to establish a single standard application program that is used world-wide, or at least internationally for the particular functions a smart card may perform. Several such potential standards for stored value cards, such as: VISA Cash, MasterCard Cash, Mondex, etc., are emerging. However, ten these applications are not operable and a terminal requires tremendous investment t all these applications. Besides, many countries and regions have already established various local applications for smart cards. Though advantageous, switching to a standard application program will require modifying or replacing all the smart cards, ATMs and merchant terminals that use existing localized application programs.

There will clearly be resistance to such an expensive project and the adoption of a universal application program for smart cards may be some distance in the future. Accordingly, there is a need for a method of using smart cards with different systems and a variety of applications that can be implemented quickly and at reasonable cost.

A first principal characteristic of smart card programming is its security system. In financial applications, security is a key concern in the use of smart cards. To inspire bank, merchant and cardholder confidence in smart card technology, smart cards must be provided with security features to prevent unauthorized use of a lost or stolen card. Smart card security features must also prevent someone from fraudulently adding value to a card and from counterfeiting a card that can access a cardholder's account.

The integrated circuits (IC's) used in smart cards are physically designed for security. For example, the key electrical signal leads are placed below the top layer of the IC construction. This helps prevent a counterfeiter from probing the leads to determine the electronic addresses at which particular data is stored. Without this information, a counterfeiter cannot successfully counterfeit or compromise a smart card.

Another example of a security feature is particularly applicable to stored value cards. When functioning as stored value cards, smart cards can be programmed and re-programmed to contain a particular value as desired by the cardholder. This value is gradually depleted as purchases are made. A merchant terminal at a point of sale may be able to simply deduct value from the smart card, or the card can be designed to require the cardholder to input a personal identification number (PIN) before value may be deducted from the card.

This security feature protects the value of the card from unauthorized use if the card is lost or stolen. A smart card may have both freely-accessible value and PIN-protected value stored on it. An ATM can be provided with options that allow the cardholder to set the value of the smart card as desired.

A smart card can have the option of allowing the user to lock and unlock the electronic purse using a personal reader device equivalent in size to a small hand held calculator.

To provide a higher level of security, a smart card system can make use of security algorithms. A security algorithm is a series of mathematical functions that can be performed on a number or alphanumeric string. With a security algorithm, an ATM or a merchant terminal will

perform the steps of the algorithm on a randomly generated string. This is called encryption.

The result is communicated by the ATM or merchant terminal to the smart card. The smart card then performs the steps of the algorithm in reverse order on the encrypted string provided by the ATM or merchant terminal. This is called decryption. An encryption key is a specific number or string that is used to govern the behavior of the encryption/decryption process. If the smart card has the correct algorithm and encryption key, it will generate the same string with which the ATM or merchant terminal started.

Encryption and decryption, also called ciphering and deciphering, prevent someone from counterfeiting a smart card as long as the encryption keys are known only to the user of the smart card and the entity supporting the ATM and merchant terminal system. If the smart card's result is the same string with which the ATM or merchant terminal started, the smart card is authenticated and the desired transaction may proceed.

Two types of encryption schemes now in use are an asymmetric encoding system and a symmetrical encoding system In a symmetrical encoding system, both encipher and decipher use an identical key. In order to maintain the security for the whole system, this key must be kept

secret. Several symmetrical encoding system which have been adopted by the industry are entitled the Data Encryption Standard (DES) and computer in an automatic teller machine (ATM) or in a merchant terminal at a point of sale must interface with the microcomputer in the smart card.

To be interfaced, the terminal computer and the computer in the smart card must have compatible application software. However, ATMs in different countries or regions may use different application programs According to the present invention, a smart card is provided that can be programmed to operate using any local application program.

The smart card of the present invention has at least two allocated areas of memory or modules. The first memory module is programmed with the application program that is prevalent in the cardholder's home country or region. The second memory module is available for programming to enable the smart card to function using a different application program, one that where the cardholder is traveling.

According to the principles of the present invention, a smart card signals which application programs it can function with compatibly. The card also indicated to the ATM that it is programmable. The ATM is

designed to recognize such a message from the smart card and signal the card whether or not the card is programmed with application programming supply the ATM.

If no such compatibility exists, the ATM is designed to offer the cardholder an option to add programming to the smart card that will then allow it to transact with the ATM. If the cardholder accepts, the ATM will add the programming to the smart card so that the smart card can be used with that ATM and all other card terminals in the area that rely on the same application program.

In this invention, it is assumed that:

- The financial institution has been authorized to create application structure in a smart card to support a local SVC application, and
- The smart card's file structure is capable of being altered under a secure, special access control after the structure has been created.

To achieve the stated and other objects of the present invention, as embodied and described below, the invention may comprise:

- an automatic machine; and
- a smart card with at least one programmable application module and an interpreter module where the interpreter module manages the interface between the smart card and the automatic teller machine;

- the interpreter module uses application information from the application module to manage the interface between the smart card and the system;
- the automatic teller machine recognizes the smart card as a programmable smart card regardless of application programming in the application module; and
- the automatic teller machine programs the application module.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings illustrate the present invention and are a part of the specification. Together with the following description, the drawings demonstrate and explain the principles of the present invention. In the drawings:

Figure 1 is a block diagram of the smart card and supporting system of the present invention in a generic example.

Figure 2 is a block diagram of the smart card and supporting system of the present invention in a specific example.

Figure 3 is a flow chart showing the method steps executed by the smart card according to the present invention.

Figure 4 is a flow chart showing the method steps executed by the automatic teller machine according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Using the drawings, the preferred embodiment of the present invention will now be explained. All examples are merely illustrative. As will be recognized by those of ordinary skill in the art, the principles of the invention are applicable whenever a smart card performing any function is to be used with two systems which run incompatible application programs.

In the example of Figure 1, a smart card (1) is issued to a cardholder. Financial information, which depends on the function of the smart card, is stored in the master file (2). In the country or region where the cardholder lives, the ATM (11) and merchant terminal (7) systems for smart cards use a standard first application program for a particular financial function i.e., crediting, debiting, storing value, etc.

Smart card (1) has a first application module (4) and an ATM interpreter (3). The ATM interpreter (3) is a generalized application program that performs the basic function of smart card application programs, but does not have the specific perimeters, security features, access

conditions, and data structure rules that distinguish one smart card application program for another.

The first application module (4) contains additional programming which can fill tin the gaps for the ATM interpreter (3) to allow the ATM interpreter (3) to interface the smart card (1) with either an ATM (11) or a merchant terminal (7) that is using the first application program. The ATM interpreter (3) dynamically loads parameters from the first application module (4) characteristic of the first application program being used by the ATM (11) or merchant terminal (7). In this way, the ATM interpreter (3) can mimic the functionality of a smart card programmed specifically for use with the first application program which is being used by the ATM (11) or merchant terminal (7).

More specifically, the first application module (4) provides the ATM interpreter (3) with the proper security algorithms and with the appropriate keying scheme for use with terminals using the first application. When an ATM (11) or merchant terminal (7) using the first application seeks to authenticate the smart card (1), the appropriate response will be provided by the ATM interpreter (3) using parameters loaded from the first application module (4). Transactions between card and terminal can then proceed.

The first application module (4) also provides the ATM interpreter (3) with the access condition parameters as they are defined by the first application program. The ATM interpreter (3) then allows access to the master file (2) based on the access conditions of the first application used by the ATM (11) or merchant terminal (7).

To present the proper data structure to the ATM, the first application module (4) provides a map that maps the data location of the data in the master file (2) with the data

structure specified by the first application program. Thus, when an ATM (11) or merchant terminal (7) using the first application attempts to access data from the smart card (1) according to the data structure used by the first application program, the ATM interpreter (3), using the data map provided by the first application module (4), will interpret the request and access the correct data in the master file (2) even if it is located differently (i.e. is organized in a different data structure with a different electronic address) than the first application specifies.

The smart card (1) also comprises a programmable application module (5). In the present example, the cardholder desires to use the smart card (1) during a

trip to another country or region. In the second country or region, ATMs (9) and merchant terminals (8) use a second application program which is different from and incompatible with the first application program used in the cardholder's home country or region. Thus, before the cardholder's smart card (1) can be used in the second country or region, the programmable application module (S) must be programmed to function as a second application module (6). Once programmed, the second application module (6) enables the smart card (1) to interact with ATMs 9 and merchant terminals (8) that use the second application program in exactly the same manner as described above.

According to the principles of the present invention, the programming of the programmable application module (5) to a second application module (6) can be performed at the ATM (11) in the cardholders home region or the ATM (9) after the card holder has begun traveling. Having the card programmed with a new application after it is brought into a new country where that new application is used may be necessary if the country involved has strict controls on the export of security algorithms or other application components that are used in that country.

If the smart card is not programmed with a second application module (6) until it arrives in the second country or region the ATM (9) using the second application program must be able to recognize the smart card (1) as a card that can be programmed with the local application program. This is accomplished by designing the ATM interpreter (3) to send a message to the ATM (9) indicating what application programs the smart card has been programmed for and that the card is programmable. This message may be a part of the ATR or may be a message sent soon after the ATR.

Accordingly, the ATMs in each country and region must be designed to recognize this message from the ATM interpreter (3) and to respond to the card by designating which, if any, of the application programs available on the card is used by the ATM (9).

If the ATM (9) does not use or support an application program compatible with any programmed on the smart card, the ATM may give the cardholder the option to program the smart card (1) with the local application program which the ATM (9) does use. If the cardholder assents, the ATM (9) may then program the second application module (6) with programming compatible with the second application program and the transaction may then proceed.

This is best accomplished if the same financial institution owns and operates the ATMS used by the cardholder in both countries and both ATMs are connected to the same international ATM network (10). Thus, when the cardholder arrives in the second region or country, if the smart card (1) has not already been programmed with the second application program, the cardholder's smart card (1) will still be recognized as an application programmable smart card because of the message sent by the ATM interpreter (3).

Alternatively, this entire process of programming could be performed at the ATM (11) using the first application program, if the cardholder anticipates a trip to the country or region where the second application program is prevalent. The ATM (11) would be designed to provide an option allowing the cardholder to request programming for a second application program. The ATM (11) would then provide a menu of various application programs available that can be added to the cardholder's card as a second application program in the application programmable module (5). In this example, the first application module (4) remains unchanged.

The smart card (1) depicted on the right of Fig. 1 indicates the smart card is in the country or region where the ATMs and merchant terminals use the first

application program. Accordingly, the first application module (4) is highlighted to indicate that the first application programming is being used by the ATM interpreter (3) to govern the interface between the card (1) and the ATM (11) or merchant terminal (7).

The smart card (1) depicted on the left of Fig. 1 indicates the smart card is in the second country or region where the second application program is used by the ATMs (9) and merchant terminals (8). When the smart card (1) is interfaced with the ATM (9) or merchant terminal (8), the ATM interpreter (3) will be informed that the second application program is recognized by the system and will accordingly use the programming in the second application module (6) to govern the interface.

If the smart card is then returned to the first area where the first application program is used, no reprogramming is necessary. The ATM interpreter module will be informed that the ATM (11) or the merchant terminal (7) use the first application program and will accordingly use the information still stored in the first application module 4 to govern the interface between the card (1) and the ATM (11) or terminal (7).

The ATM interpreter (3) thus acts as a switch that makes use of the appropriate application module depending on the application used by the ATM or merchant terminal.

This is accomplished by designing the ATM interpreter to address the memory locations of either of the two application modules depending on which module contains the programming needed. While the first application module (4) remains programmed with the first application programming, the second application module 6 may be reprogrammed with a third application for another country or region if the cardholder anticipates or experiences the need for doing so.

Figure 2 illustrates a specific example of a stored value smart card that is used in Germany and Belgium. In the example of Figure 2, a smart card (101) is issued to a cardholder who lives in Germany. The stored value information, the account identification and the monetary amount stored are recorded in the master file (102). In Germany, the ATM 111 and merchant terminal (107) systems for stored value cards use an application program standardized by the national banking authority, ZKA. Thus, smart card (101) has a ZKA application module 104 that is programmed with the information needed to allow the ATM interpreter (103) to interact with either a German ATM 111 or a German merchant terminal (107) that is running the ZKA application program for stored value cards.

The ZKA module (104) provides the ATM interpreter (103) with the security algorithms and keying scheme used with the ZKA application program. Accordingly, when a German ATM (111) or merchant terminal (107) which is executing the ZXA application program seeks to authenticate the smart card (101), the appropriate response can be provided by the ATM interpreter (103).

The ZKA module (104) also provides the access conditions used by the ZKA application program to the ATM interpreter (103). The ATM interpreter (103) then allows access to the master file (102) based on the ZKA access conditions that the ZKA-based ATM (111) or merchant terminal (107) expect.

To present the proper data structure, the ZKA ,module (104) provides a map that maps the data structure of the data in the master file (102) to the standard ZKA data structure. Thus, when a ZKA-based ATM (111) or merchant terminal (107) attempts to access data from the smart card (101) according to the ZKA data structure, the ATM interpreter (103), using the data map provided by the ZKA module (104), will interpret the request and access the correct data in the master file (102) even if it is located differently (i.e. is organized in a different data structure) than the standard ZKA data structure.

The smart card (101) also comprises a programmable application module (105). In the present example, the cardholder desires to use the smart card (101) during a trip to Belgium. In Belgium, ATMs (109) and merchant terminals (108) for stored value cards use an application program called Proton.

Thus, before the smart card (101) can be used in Belgium with Proton-based ATMs (109) and merchant terminals (108), the programmable application module (105) must be programmed to function as a Proton module (106). Once programmed, the Proton module (106) enables the smart card (101) to interact with Proton based ATMs (109) and merchant terminals (108) in exactly the same manner as the ZKA module 104 allows interaction with ZKA-based systems described above.

The programming of the programmable application module (105) to a Proton module (106) can be performed at the German ATM (111) or the Belgian ATM (109). If the smart card is not programmed with a Proton module (106) until it arrives in Belgium, the Belgian ATM (109) must be designed to recognize the smart card (101) as a card using a foreign application that can be programmed with the local application. This is accomplished by designing the ATMs to recognize the messages sent by the ATM interpreter (103) which lists the applications the card

has been programmed to support and to inform the ATM that the card is programmable. The Belgian ATM (109) will then give the cardholder the option to program the smart card (101) with the Proton application program.

Again, this is best accomplished if the same financial institution owns and operates the ATMs in both countries and the ATMs are connected to the same international ATM network (110). Thus, when the German cardholder arrives in Belgium, the cardholder's smart card (101) will be recognized application programmable smart card because of the message from the ATM interpreter (103). The Belgian ATM (109) will then ask the cardholder for permission to program the programmable application module (105) with the Proton application (106).

Once this is accomplished, because the ATMs (109) and (111) are tied to the same financial institution, the German cardholder can remove funds from his account in Germany. The funds are processed through a funds exchanger (FX) that uses the current conversion rate to convert the funds from German deutschmarks to Belgian franks. The amount in franks is then stored as a value on the newly programmed smart card (101) which can be used at a Belgian merchant terminal 108 to pay for a purchase.

Alternatively, this entire process of programming and converting funds could be performed at the German ATM (111) if the cardholder anticipates a trip to Belgium. When the cardholder no longer needs Belgian francs stored on the smart card (101), the cardholder can use either the Belgian ATM (109) or the German ATM (111) to process the stored franks through the funds exchanger and return the remaining value in deutschmarks to the cardholder's German account. Because the cardholder in the example is German, the ZKA module 104 remains on the card. When the smart card (101) is returned to Germany, it can be used with a ZKA-based ATM (111) or merchant terminal (107) without being reprogrammed.

Figure 3 is a flow chart illustrating the steps in the method of the present invention as they are executed by the smart card. In step S1, the smart card is physically interfaced with an ATM. In step S2, the smart card receives a reset (RST) signal from the ATM. The card uses this signal to reset itself or to initiate a reset procedure.

In step S3, the smart card responds to the ATM with an answer-to-reset (ATR) signal. The ATM interpreter then sends a message that informs the ATM which application programs the smart card has been programmed to function with and that the card is programmable.

In step S4, the card receives a message from the ATM indicating which, if any, of the application programs available on the smart card the ATM can support. If the ATM indicates that it can support one of the applications programmed on the card, in step S8, the transaction supported by that application can proceed.

If the ATM does not support any applications for which the card is programmed, the ATM may attempt to add application programming to the smart card. If the ATM cannot add programming to the card, the transaction cannot proceed, step S9. If the ATM does add programming to the smart card, a new application module will be created on the card in step S6. In step S7, the ATM interpreter will use the new programming added to the card to successfully transact with the ATM in step S8.

Figure 4 is a flow chart illustrating the steps in the method of the present invention as they are executed by an ATM. In step S101, the smart card is physically interfaced with the ATM. In step S102, the ATM sends the RST signal to the smart card. In step S103, the ATM receives the signal from the smart card indicating which applications the smart card can support and whether or not the smart card is programmable for other application programs.

In step S104, the ATM determines whether the smart card supports an application recognized by the ATM. If 80, in step S109, a transaction in that application can proceed. If not, the ATM will determine, based on the signal received from the card, whether the smart card is programmable. If the card is not programmable, in step S110, the transaction cannot proceed. If the card is programmable, in step S106, the ATM offer the cardholder an option to add application programming to the smart card so that it may transact with the ATM.

In step S107, the cardholder responds. If the car & older refused permission to add programming to the card, in step S110, the transaction cannot proceed. If the cardholder requests that the ATM add programming to the card, the ATM will do so in step S108. After the new application programming has been added to the card, in step S109, the transaction between the card and the ATM can proceed based on that application.

The proceeding description has been presented only to illustrate and describe the invention. It is not intended to be exhaustive or to limit the invention to any precise form disclosed. Many modifications and variations are possible in light of the above teaching.

The preferred embodiment was chosen and described in order to best explain the principles of the invention and

its practical application. The preceding description is intended to enable others skilled in the art to best utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the following claims.

WHAT IS CLAIMED IS:

1. An application programmable smart card comprising: an interpreter which manages an interface between the smart card and a system transacting with the smart card; and at least one application module programmed with an application for interfacing the smart card with the system; wherein the interpreter uses application information from the application module to manage the interface between the smart card and the system.

2. A smart card as claimed in claim 1, further comprising:

at least two application modules each programmed with different application programming.

3. A smart card as claimed in claim 2, wherein a first application module is programmed with application programming used in a first country or region and a second application module is programmed with different application programming used in a second country or region.

4. A smart card as claimed in claim 2, wherein the interpreter signals the system what application programming is available on the smart card in the at least one application module and that the smart card is programmable.

5. A smart card as claimed in claim 4, wherein the interpreter manages the interface between the smart card and the system by using application programming from an application module programmed with the application used by the system if an application module on the smart card is programmed for use with the application used by the system.

6. A financial transaction system comprising:

an automatic teller machine;

a smart card for use with the automatic teller machine;

at least one programmable application module disposed on the smart card;

and an interpreter disposed on the smart card which manages an interface between the smart card and the automatic teller machine;

wherein the interpreter uses application programming from the at least one application module to

manage the interface between the smart card and the system.

7. A financial transaction system as claimed in claim 6, wherein the automatic teller machine comprises means for recognizing a signal from the interpreter indicating that the smart card is programmable.

8. A financial transaction system as claimed in claim 6, wherein the automatic teller machine comprises means for programming the application module with application programming.

9. A financial transaction system as claimed in claim 8, further comprising: at least two application modules disposed on the smart card wherein a first application module is programmed with an application used in a first country or region and a second application module is programmed with a different application by the automatic teller machine for use in a second country or region.

10. A financial transaction system as claimed in claim 6, wherein the interpreter comprises means for

signaling the automatic teller machine what application programming is available on the smart card.

11. A financial transaction system as claimed in claim 10, wherein the interpreter manages the interface between the smart card and the automatic teller machine using application information from an application module programmed containing application programming compatible with an application used by the system.

12. A financial transaction system as claimed in claim 11, wherein the automatic teller machine comprises means for programming an application module on the smart card with application programming compatible with an application used by the automatic teller machine.

13. A method of using a smart card with a variety of applications comprising the steps of:

providing an interpreter on the smart card which manages an interface between the smart card and a system transacting with the smart card; and

providing at least one application module on the smart card that is programmed with an application for interfacing the smart card with the system;

wherein the interpreter uses application information from the application module to manage the interface between the smart card and the system.

14. A method as claimed in claim 13, further comprising the step of providing at least two application modules each programmed with different application programming.

15. A method as claimed in claim 14, further comprising the steps of:

programming a first application module with application programming compatible with an application used in a first country or region; and

programming a second application module with application programming compatible with a different application used in a second country or region.

16. A method as claimed in claim 14, further comprising the steps of:

signaling, with the interpreter, what application programming is available on the smart card; and

signaling, with the interpreter, that the smart card is programmable.

17. A method as claimed in claim 16, further comprising the step of managing the interface between the smart card and the system with the interpreter which uses application programming from an application module programmed with programming compatible with the application used by the system.

18. A method of providing a smart card using a variety of applications comprising the steps of:

providing an automatic teller machine;

providing a smart card for use with the automatic teller machine; providing at least one programmable application module disposed on said smart card;

providing an interpreter disposed on said smart card; and

managing an interface between the smart card and the automatic teller machine with the interpreter which uses application programming from the application module to manage the interface between the smart card and the automatic teller machine.

19. A method as claimed in claim 18, further comprising the steps of:

signaling the automatic teller machine with the interpreter what application programming is available on the smart card and that the smart card is programmable.

20. A method as claimed in claim 18, further comprising the step of using the automatic teller machine to program the application module with application programming.

21. A method as claimed in claim 20, further comprising the steps of: providing at least two application modules disposed on the smart card;

programming a first application module with application programming compatible with an application used in a first country or region; and

programming a second application module with different application programming compatible with an application used in a second country or region;

wherein the second application module is programmed by the automatic teller machine.

22. A method as claimed in claim 18, further comprising the steps of: signaling the smart card with the automatic teller machine which application is used by the automatic teller machine.

23. A method as claimed in claim 22, further comprising the step of managing the interface between the smart card and the automatic teller machine with the interpreter using application programming from an application module programmed with application programming compatible with the application used by the automatic teller machine.

24. A method as claimed in claim 23, further comprising the steps of using the automatic teller machine to program an application module on the smart card with application programming compatible with the application used by the automatic teller machine.

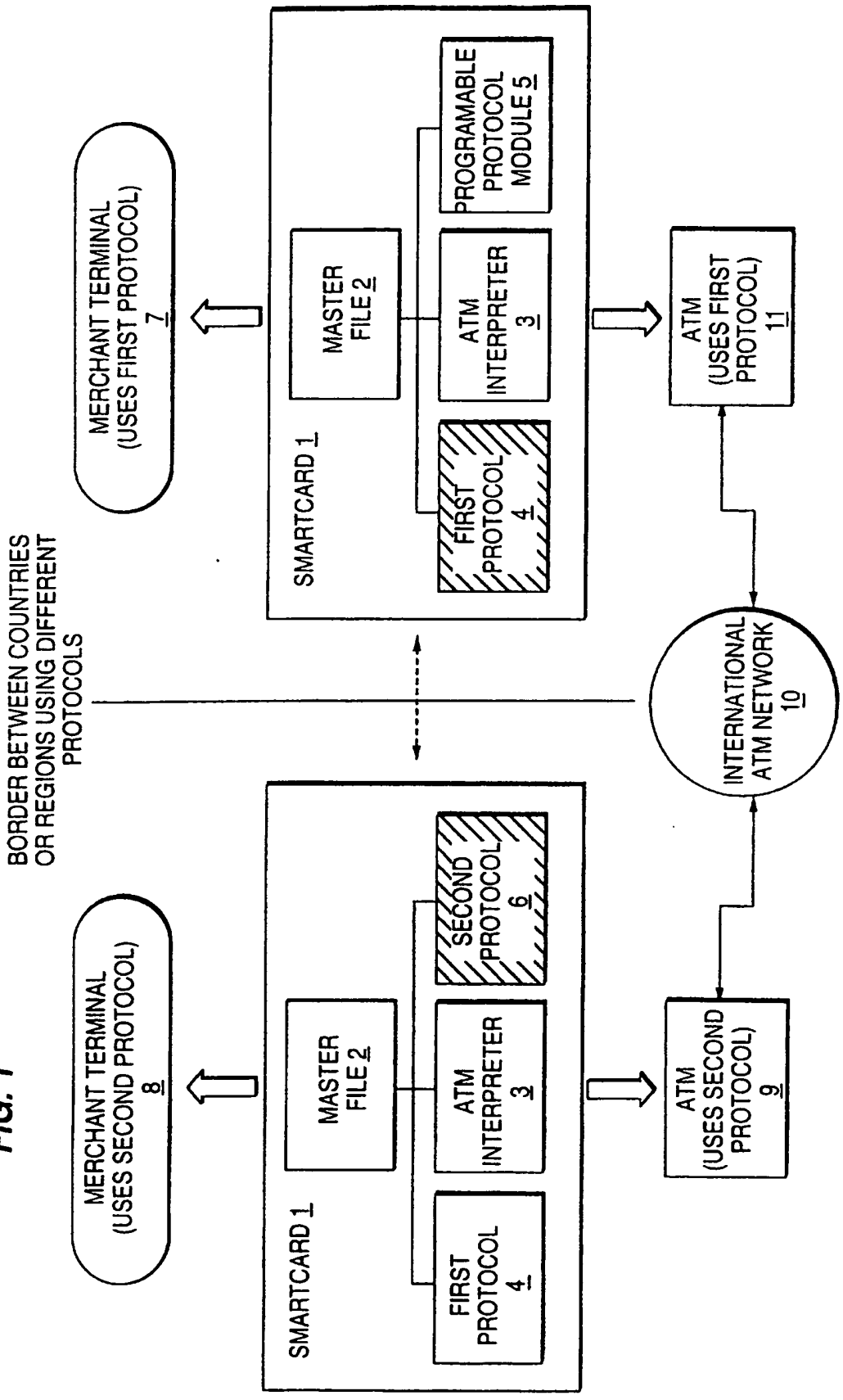
MERCHANT TERMINAL (USES FIRST PROTOCOL) 7
SMARTCARD 1
MASTER FILE 2
ATM INTERPRETER 3
PROGRAMABLE PROTOCOL MODULE 5
FIRST PROTOCOL 4
ATM (USES FIRST PROTOCOL) 11
BORDER BETWEEN COUNTRIES OR REGIONS USING DIFFERENT PROTOCOLS
INTERNATIONAL ATM NETWORK 10
MERCHANT TERMINAL (USES SECOND PROTOCOL) 8
SMARTCARD 1
MASTER FILE 2
ATM INTERPRETER 3
SECOND PROTOCOL 6
FIRST PROTOCOL 4
ATM (USES SECOND PROTOCOL) 9

FIG. 1

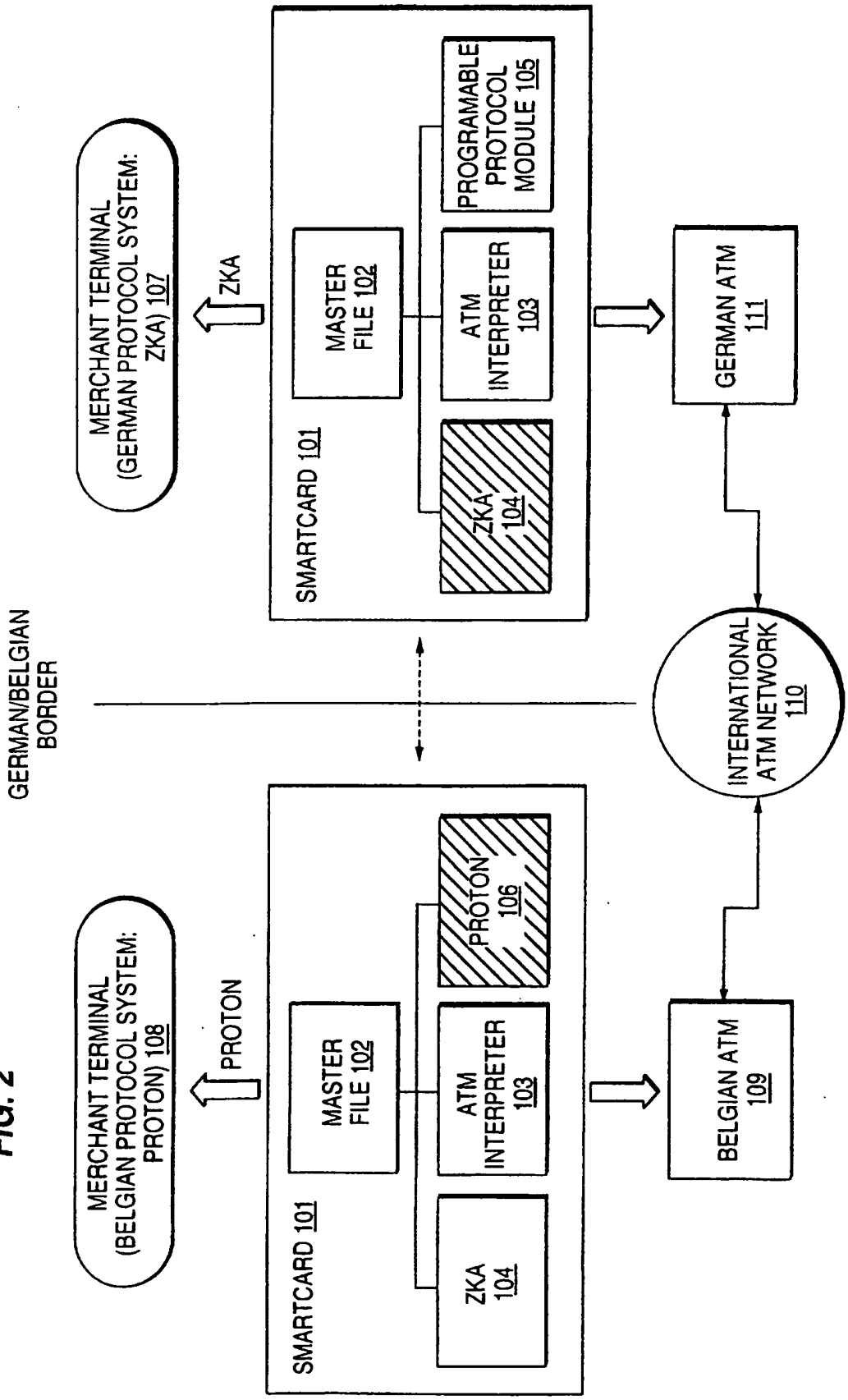
MERCHANT TERMINAL (GERMAN PROTOCOL SYSTEM: ZKA) 107
ZKA
SMARTCARD 101
MASTER FILE 102
ATM INTERPRETER 103
PROGRAMABLE PROTOCOL MODULE 105
ZKA 104
GERMAN ATM 111
GERMAN/BELGIAN BORDER
INTERNATIONAL ATM NETWORK 110
MERCHANT TERMINAL (BELGIAN PROTOCOL SYSTEM: PROTON) 108
PROTON
SMARTCARD 101
MASTER FILE 102
ATM INTERPRETER 103
PROTON 106
ZKA 104
BELGIAN ATM 109

FIG. 2

3/4

FIG. 3

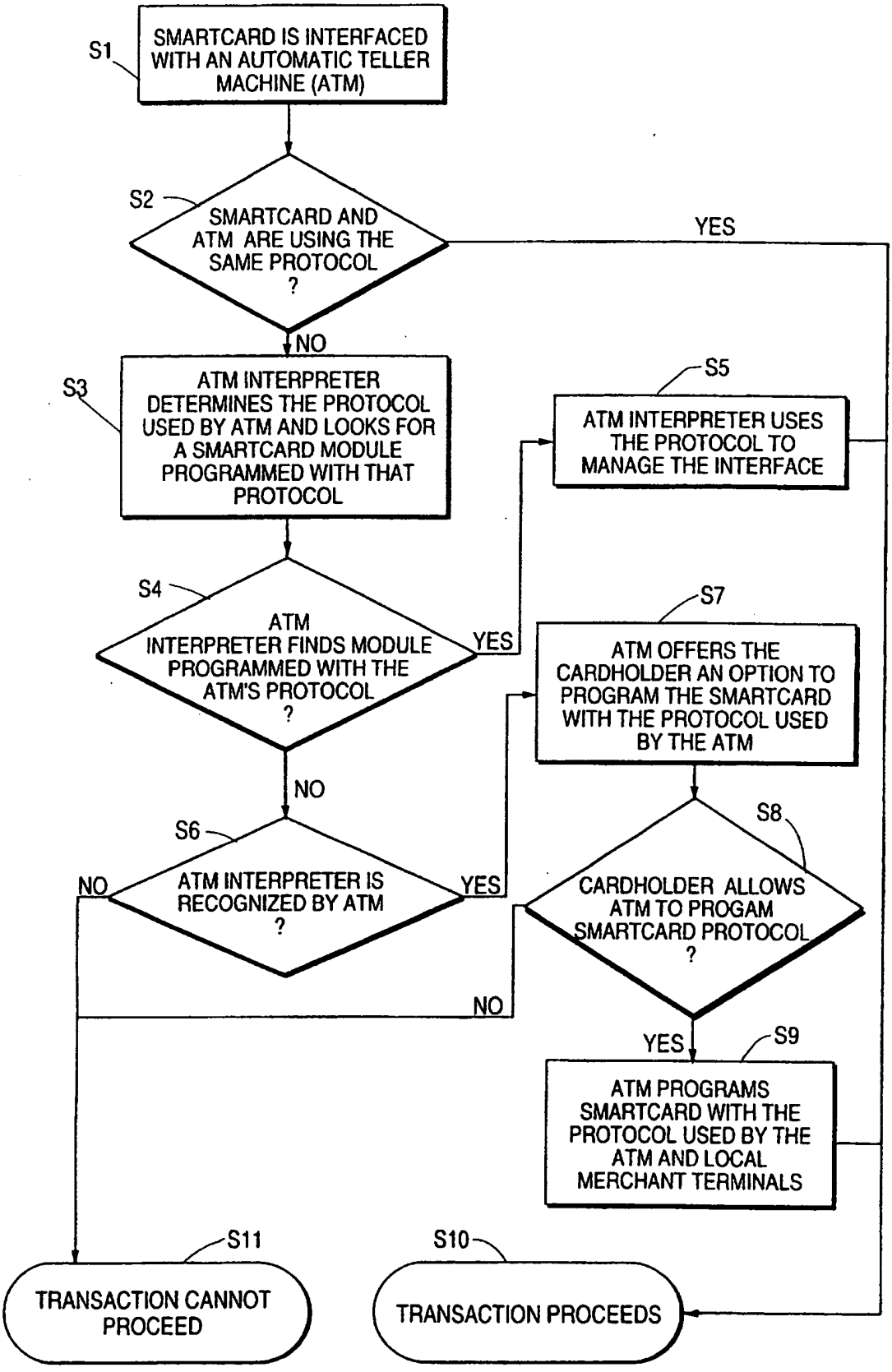
S1
SMARTCARD IS INTERFACED WITH AN AUTOMATIC TELLER MACHINE (ATM)
S2
SMARTCARD AND ATM ARE USING THE SAME PROTOCOL ?
YES
NO
S3
ATM INTERPRETER DETERMINES THE PROTOCOL USED BY ATM AND LOOKS FOR A SMARTCARD MODULE PROGRAMMED WITH THAT PROTOCOL
S5
ATM INTERPRETER USES THE PROTOCOL TO MANAGE THE INTERFACE
S4
ATM INTERPRETER FINDS MODULE PROGRAMMED WITH THE ATM'S PROTOCOL ?
YES
S7
ATM OFFERS THE CARDHOLDER AN OPTION TO PROGRAM THE SMARTCARD WITH THE PROTOCOL USED BY THE ATM
NO
S6
ATM INTERPRETER IS RECOGNIZED BY ATM ?
NO
YES
S8
CARDHOLDER ALLOWS ATM TO PROGAM SMARTCARD PROTOCOL ?
NO
YES
S9
ATM PROGRAMS SMARTCARD WITH THE PROTOCOL USED BY THE ATM AND LOCAL MERCHANT TERMINALS
S11
TRANSACTION CANNOT PROCEED
S10
TRANSACTION PROCEEDS

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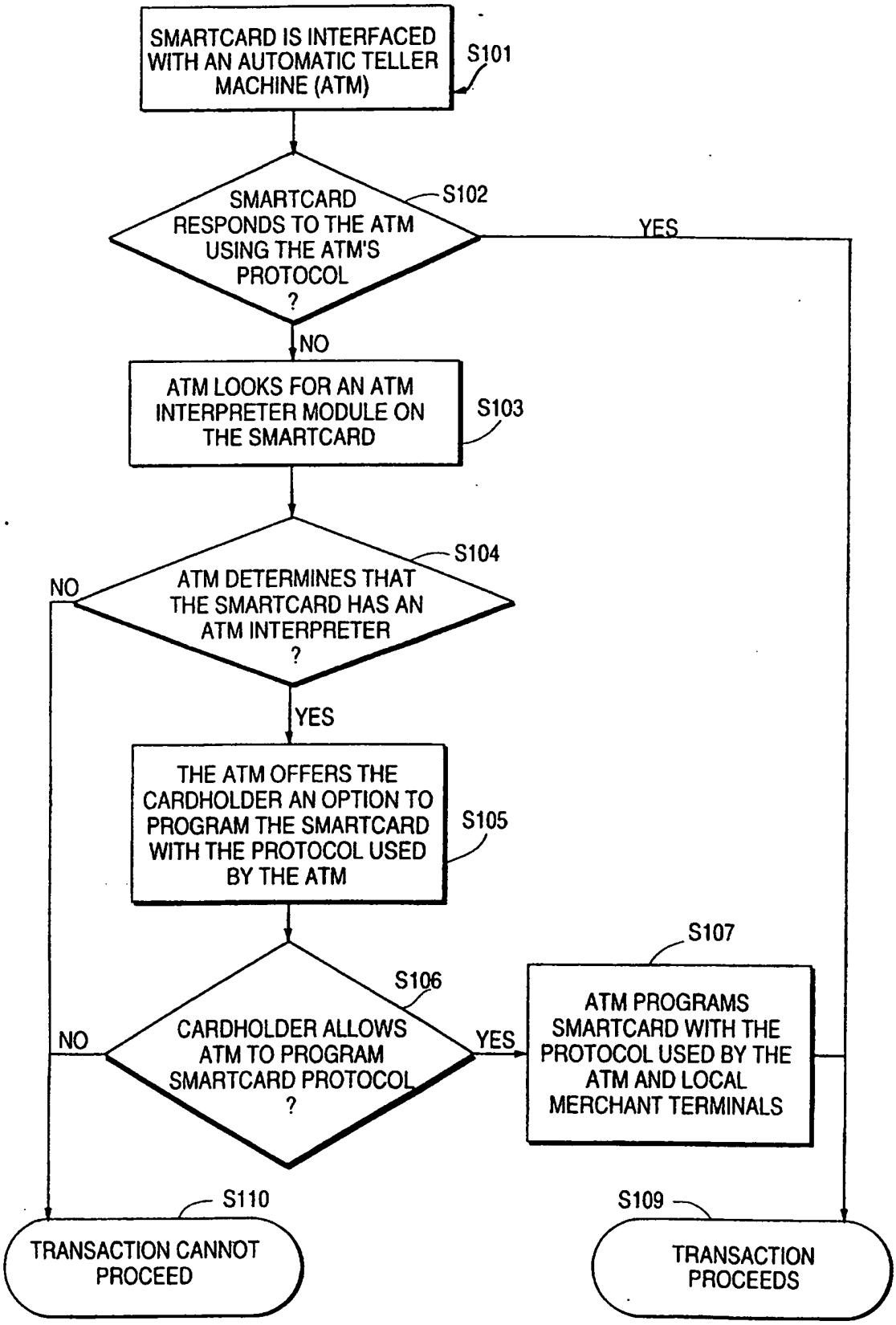
FIG. 4


SMARTCARD IS INTERFACED WITH AN AUTOMATIC TELLER MACHINE (ATM)
S101
SMARTCARD RESPONDS TO THE ATM USING THE ATM'S PROTOCOL ?
S102
YES
NO
ATM LOOKS FOR AN ATM INTERPRETER MODULE ON THE SMARTCARD
S103
ATM DETERMINES THAT THE SMARTCARD HAS AN ATM INTERPRETER ?
S104
NO
YES
THE ATM OFFERS THE CARDHOLDER AN OPTION TO PROGRAM THE SMARTCARD WITH THE PROTOCOL USED BY THE ATM
S105
CARDHOLDER ALLOWS ATM TO PROGRAM SMARTCARD PROTOCOL ?
S106
NO
YES
ATM PROGRAMS SMARTCARD WITH THE PROTOCOL USED BY THE ATM AND LOCAL MERCHANT TERMINALS
S107
TRANSACTION CANNOT PROCEED
S110
TRANSACTION PROCEEDS
S109

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/20290

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :G06F 17/60; G06K 19/06
US CL :235/379, 492; 902/8, 21, 25, 26
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 235/379, 492; 902/8, 21, 25, 26

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS search terms: smart card, programmable, ATM

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 4,709,137 (Yoshida) 24 November 1987 (24.11.87), column 5, lines 36-42 and lines 65-68 column 2, lines 67-68 and column 3, lines 1-10 column 2, lines 47-55 and column 4, lines 42-54	1-2, 4-8, 10-14, 16-20, 22-24
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Y		3, 9, 15, 21

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 23 MARCH 1997	Date of mailing of the international search report 08 APR 1997
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer DOUGLAS X. RODRIGUEZ Telephone No. (703) 308-4081

Form PCT/ISA/210 (second sheet)(July 1992)*